CLAIM AMENDMENTS

1. (Previously presented) An imaging method for detecting misalignment of two periodic structures placed next to each other with respect to a reference plane, comprising:

providing radiation to illuminate the two periodic structures along directions that are substantially normal or near normal to the reference plane;

collecting radiation from the two structures and directing the collected radiation to form images of at least portions of the two structures on an array of detectors, wherein the image of the portion(s) of one of the two structures is substantially distinct from the image of the portion(s) of the remaining one of the two structures; and

determining a misalignment between the structures from outputs of the detectors.

2. (Original) The method of claim 1, wherein said determining includes finding a phase difference between outputs of the detectors.

3. (Cancelled)

4. (Original) The method of claim 1~~3~~, wherein the collecting collects radiation from the two structures along directions at oblique angles to the reference plane.

5. (Original) The method of claim 1, wherein said providing provides a beam of radiation so that the beam is at an oblique angle to the reference plane.

6. (Original) The method of claim 5, wherein the collecting collects radiation from the two structures along directions that are substantially normal or near normal to the reference plane.

7. (Original) The method of claim 1, wherein said providing provides a beam of radiation that illuminates the entire extent of both structures simultaneously.

8. (Original) The method of claim 1, each of said structures comprising an array of lines, said method further comprising summing the outputs of the detectors detecting radiation imaged onto the detectors from a line of one of the structures.

9. (Original) The method of claim 1, said two structures being periodic substantially along a direction, wherein said determining includes cross-correlating intensities of the radiation detected from adjacent lines of the two structures across at least two or more of the lines of each of the structures.

10. (Original) The method of claim 1, wherein said providing provides a laser beam or a broadband beam having multiple wavelengths.

11. (Original) The method of claim 10, wherein said providing provides a laser beam and said collecting collects radiation only along directions away from a specular reflection direction of the laser beam with respect to the reference plane.

12 (Original) The method of claim 1, wherein said collecting collects radiation from the structures only along one or more directions away from any specular reflection direction(s) of the beam.

13. (Cancelled)

14. (Previously presented) A method for detecting misalignment of two structures placed next to each other with respect to a reference plane, comprising:

providing a beam of radiation to illuminate a portion of each of the two structures;

collecting radiation from the illuminated portion of each of the two structures and directing the collected radiation from each structure to a corresponding detector through a corresponding one of two apertures;

determining a misalignment between the structures from outputs of the detectors; and

causing relative motion between the apertures and detectors on one hand and the two structures on the other, or between the beam on one hand and the two structures on the other.

15. (Previously presented) The method of claim 14, wherein said collecting and directing employ optics, the two structures being at different distances from said optics, said method further comprising locating said apertures so that the image of each of the two structures is focused by the optics substantially to the corresponding aperture.

16. (Currently amended) An imaging apparatus for detecting misalignment of two periodic structures placed next to each other with respect to a reference plane, comprising:

a source providing a beam of radiation illuminating the two periodic structures along directions that are substantially normal or near normal to the reference plane;

an array of detectors;

optics collecting radiation from the two structures and directing the collected radiation to form images of at least portions of the two structures on the array of detectors which provide outputs, wherein the image of the portion(s) of one of the two structures is substantially distinct from the image of the portion(s) of the remaining one of the two structures; and

a processor determining a misalignment between the structures from a phase difference between the outputs of the detectors.

17. (Original) The apparatus of claim 16, wherein said array includes a two dimensional array of detectors.

18. (Cancelled)

19. (Currently amended) The apparatus of claim 16~~8~~, wherein the optics collects radiation from the two structures along directions at oblique angles to the reference plane.

20. (Original) The apparatus of claim 16, wherein said source provides the beam so that the beam is at an oblique angle to the reference plane.

21. (Original) The apparatus of claim 20, wherein the optics collects radiation from the two structures along directions that are substantially normal or near normal to the reference plane.

22. (Currently amended) The apparatus of claim 16, wherein said ~~source provides a~~ beam of radiation ~~that~~ illuminates the entire extent of both structures simultaneously.

23. (Original) The apparatus of claim 16, each of said structures comprising an array of lines, said processor summing the outputs of the detectors detecting radiation imaged onto the detectors from a line of one of the structures.

24. (Original) The apparatus of claim 16, said two structures being periodic substantially along a direction, wherein said processor cross-correlates intensities of the radiation detected from adjacent lines of the two structures across at least two or more of the lines of each of the structures.

25. (Original) The apparatus of claim 16, wherein said source provides a laser beam or a beam having multiple wavelengths.

26. (Original) The apparatus of claim 25, wherein said source provides a laser beam and said optics collects radiation only along directions away from a specular reflection direction of the laser beam with respect to the reference plane.

27. (Original) The apparatus of claim 16, wherein said optics includes a refractive element that directs radiation from the source to the two structures and that collects radiation from the two structures.

28. (Original) The apparatus of claim 27, said refractive element having a numerical aperture in the range of about 0.1 to 0.9.

29. (Original) The apparatus of claim 28, said refractive element having a numerical aperture in the range of about 0.4 to 0.8.

30. (Original) The apparatus of claim 29, said refractive element having a numerical aperture in the range of about 0.5 to 0.7.

31. (Original) The apparatus of claim 16, said detectors having an integration time less than about 10 milliseconds.

32. (Original) The apparatus of claim 16, said source providing a beam of radiation to illuminate the structures, wherein said optics collects radiation only along one or more directions away from any specular reflection direction of the beam from the reference plane

33. (Original) The apparatus of claim 16, said source providing a beam of radiation to illuminate the structures, wherein said optics collects radiation along one or more specular reflection directions of the beam from the reference plane.

34. Cancelled.

35. (Previously presented) An apparatus for detecting misalignment of two structures placed next to each other with respect to a reference plane, comprising:

a source providing a beam of radiation to illuminate a portion of each of the two structures;

one or more detectors;

two apertures;

optics collecting radiation from the illuminated portion of each of the two structures and directing the collected radiation from each structure to a corresponding detector through a corresponding one of the two apertures, causing the corresponding detector to provide an output;

a processor determining a misalignment between the structures from output(s) of the detector(s); and

an instrument causing relative motion between the apertures and detectors on one hand and the two structures on the other, or between the beam on one hand and the two structures on the other.

36. (Previously presented) The apparatus of claim 35, the two structures being at different distances from said optics, wherein the two apertures are located so that said optics causes the image of each of the two structures to be focused substantially to the corresponding aperture.

37. (Currently amended) An imaging apparatus for detecting misalignment of two structures on two different planes and placed next to each other with respect to a reference plane, comprising:

a source providing a beam of radiation illuminating the two structures;

a detector array with one or more detectors;

optics collecting radiation from the two structures and directing the collected radiation to form images of at least portions of the two structures on the detector array, wherein the one or more detectors ~~which~~ provide outputs, and the two structures are at different distances from said optics, said optics having a numerical aperture in the range

of about 0.1 to 0.9<u>, wherein the image of the portion(s) of one of the two structures is substantially distinct from the image of the portion(s) of the remaining one of the two structures</u>; and

a processor determining a misalignment between the structures from outputs of the detectors<u> without requiring more than a single measurement using said optics</u>.

38. (Original) The apparatus of claim 37, said optics having a numerical aperture in the range of about 0.4 to 0.8.

39. (Original) The apparatus of claim 38, said optics having a numerical aperture in the range of about 0.5 to 0.7.

40. (Original) The apparatus of claim 37, wherein said one or more detectors include a CCD detector.

41. (Original) The apparatus of claim 37, said one or more detectors having an integration time less than about 10 milliseconds

42. (Original) The apparatus of claim 37, said source providing pulses of radiation illuminating the two structures, wherein at least one of the pulses has a pulse width less than about 10 milliseconds.

43. (Original) The apparatus of claim 42, said source comprising a mechanical shutter with aperture time of less than about 10 milliseconds.

44. (Original) The apparatus of claim 37, further comprising a mechanical shutter with aperture time of less than about 10 milliseconds in an optical path between the structures and the one or more detectors..

45. (Currently amended) An imaging method for detecting misalignment of two structures on two different planes and placed next to each other with respect to a reference plane, comprising:

providing a beam of radiation illuminating the two structures;

providing a detector array with one or more detectors;

using optics to collect radiation from the two structures and direct the collected radiation to form images of at least portions of the two structures on the detector array, wherein the one or more detectors ~~which~~ provide outputs, and the optics is at different distances from the two structures, said optics having a numerical aperture in the range of about 0.1 to 0.9, wherein the image of the portion(s) of one of the two structures is substantially distinct from the image of the portion(s) of the remaining one of the two structures; and

determining a misalignment between the structures from outputs of the detectors without requiring more than a single measurement using said optics.

46. (Original) The method of claim 45, wherein said using uses optics having a numerical aperture in the range of about 0.4 to 0.8.

47. (Original) The method of claim 46, wherein said using uses optics having a numerical aperture in the range of about 0.5 to 0.7.

48. (Original) An imaging apparatus for detecting misalignment of two structures placed next to each other with respect to a reference plane, comprising:

a source providing a beam of radiation illuminating the two structures;

one or more detectors having an integration time less than about 10 milliseconds;

optics collecting radiation from the two structures and directing the collected radiation to the one or more detectors which provide outputs; and

a processor determining a misalignment between the structures from outputs of the detectors.

49. (Original) An imaging apparatus for detecting misalignment of two structures placed next to each other with respect to a reference plane, comprising:

a source providing pulses of radiation illuminating the two structures, wherein at least one of the pulses has a pulse width less than about 10 milliseconds;

one or more detectors;

optics collecting radiation from the two structures and directing the collected radiation to the one or more detectors which provide outputs; and

a processor determining a misalignment between the structures from outputs of the detectors.

50. (Original) The apparatus of claim 49, said source comprising a mechanical shutter with aperture time of less than about 10 milliseconds.

51. (Currently amended) An integrated processing and imaging apparatus for processing a sample having two structures on two different planes, comprising:

(a) an imaging system for detecting misalignment of the two structures placed next to each other with respect to a reference plane, said system comprising:

a source providing a beam of radiation illuminating the two structures;

optics collecting radiation from the two structures and directing the collected radiation to ~~the~~ one or more detectors of a detector array to form images of at least portions of the two structures on the detectors, which provide outputs, wherein the image of the portion(s) of one of the two structures is substantially distinct from the image of the portion(s) of the remaining one of the two structures, wherein the optics is at different distances from the two structures; and

a processor determining a misalignment between the structures from outputs of the detectors, wherein said optics has a numerical aperture such that said misalignment is determinable without performing more than a single measurement using said optics; and

(b) a processing system processing said sample, said processing system responsive to the misalignment for adjusting a processing parameter.

52. (Original) The apparatus of claim 51, said optics having a numerical aperture in the range of about 0.1 to 0.9.

53. (Original) The apparatus of claim 52, said optics having a numerical aperture in the range of about 0.4 to 0.8.

54. (Original) The apparatus of claim 53, said optics having a numerical aperture in the range of about 0.5 to 0.7.

55. (Original) The apparatus of claim 51, said processing system including a stepper or an etcher for processing a semiconductor sample.

56. (Original) The apparatus of claim 51, wherein said one or more detectors include a CCD detector

57. (Original) The apparatus of claim 51, wherein said one or more detectors have an integration time less than about 10 milliseconds.

58. (Original) The apparatus of claim 51, said source providing pulses of radiation illuminating the two structures, wherein at least one of the pulses has a pulse width less than about 10 milliseconds.

59. (Original) The apparatus of claim 58, said source comprising a mechanical shutter with aperture time of less than about 10 milliseconds.

60. (Original) The apparatus of claim 51, further comprising a mechanical shutter with aperture time of less than about 10 milliseconds in an optical path between the structures and the one or more detectors.

61. Cancelled.

62. (Currently amended) The apparatus of claim ~~6~~51, said source providing a beam of radiation to illuminate the structures, wherein said optics collects radiation only along one or more directions away from any specular reflection direction of the beam from the reference plane

63. (Original) The apparatus of claim 51, wherein said optics collects radiation along one or more specular reflection directions of the beam from the reference plane.

144. (New) An imaging method for detecting misalignment of two periodic structures placed next to each other with respect to a reference plane, comprising:

providing radiation to illuminate the two periodic structures;

imaging radiation from the two structures on an array of detectors to form an image of at least portions of each of the two structures on the array, causing the detectors to convert images of said portions to signal outputs, wherein the image of the portion(s) of one of the two structures is substantially distinct from the image of the portion(s) of the remaining one of the two structures; and

determining a misalignment between the structures by comparing said image of portion(s) of one of the two structures, or an image derived therefrom, to said image of portion(s) of the other one of the two structures, or an image derived therefrom, in signal outputs of the detectors.

145. (New) The method of claim 144, wherein said determining includes finding a phase difference between outputs of the detectors.

146. (New) The method of claim 144, wherein said providing provides a beam of radiation so that the beam illuminates the structures along directions that are substantially normal or near normal to the reference plane.

147. (New) The method of claim 146, wherein the collecting collects radiation from the two structures along directions at oblique angles to the reference plane.

148. (New) The method of claim 144, wherein said providing provides a beam of radiation so that the beam is at an oblique angle to the reference plane.

149. (New) The method of claim 148, wherein the collecting collects radiation from the two structures along directions that are substantially normal or near normal to the reference plane.

150. (New) The method of claim 144, wherein said providing provides a beam of radiation that illuminates the entire extent of both structures simultaneously.

151. (New) The method of claim 144, each of said structures comprising an array of lines, said method further comprising summing the outputs of the detectors detecting radiation imaged onto the detectors from a line of one of the structures.

152. (New) The method of claim 144, said two structures being periodic substantially along a direction, wherein said determining includes cross-correlating intensities of the radiation detected from adjacent lines of the two structures across at least two or more of the lines of each of the structures.

153. (New) The method of claim 144, wherein said providing provides a laser beam or a broadband beam having multiple wavelengths.

154. (New) The method of claim 153, wherein said providing provides a laser beam and said collecting collects radiation only along directions away from a specular reflection direction of the laser beam with respect to the reference plane.

155 (New) The method of claim 144, wherein said collecting collects radiation from the structures only along one or more directions away from any specular reflection direction(s) of the beam.

156. (New) An imaging apparatus for detecting misalignment of two periodic structures placed next to each other with respect to a reference plane, comprising:

a source providing radiation illuminating the two periodic structures;

an array of detectors;

optics imaging radiation from the two structures on an array of detectors to form an image of at least portions of the two structures on the array, causing the detectors to convert images of said portions to signal outputs, wherein the image of the portion(s) of one of the two structures is substantially distinct from the image of the portion(s) of the remaining one of the two structures; and

a processor determining a misalignment between the structures by comparing said image of portion(s) of one of the two structures, or an image derived therefrom, to said image of portion(s) of the other one of the two structures, or an image derived therefrom, in signal outputs of the detectors.

157. (New) The apparatus of claim 156, wherein said array includes a two dimensional array of detectors.

158. (New) The apparatus of claim 156, wherein said source provides a beam of radiation so that the beam illuminates the structures along directions that are substantially normal or near normal to the reference plane.

159. (New) The apparatus of claim 158, wherein the optics collects radiation from the two structures along directions at oblique angles to the reference plane.

160. (New) The apparatus of claim 156, wherein said source provides the beam so that the beam is at an oblique angle to the reference plane.

161. (New) The apparatus of claim 160, wherein the optics collects radiation from the two structures along directions that are substantially normal or near normal to the reference plane.

162. (New) The apparatus of claim 156, wherein said source provides a beam of radiation that illuminates the entire extent of both structures simultaneously.

163. (New) The apparatus of claim 156, each of said structures comprising an array of lines, said processor summing the outputs of the detectors detecting radiation imaged onto the detectors from a line of one of the structures.

164. (New) The apparatus of claim 156, said two structures being periodic substantially along a direction, wherein said processor cross-correlates intensities of the radiation detected from adjacent lines of the two structures across at least two or more of the lines of each of the structures.

165. (New) The apparatus of claim 156, wherein said source provides a laser beam or a beam having multiple wavelengths.

166. (New) The apparatus of claim 165, wherein said source provides a laser beam and said optics collects radiation only along directions away from a specular reflection direction of the laser beam with respect to the reference plane.

167. (New) The apparatus of claim 156, wherein said optics includes a refractive element that directs radiation from the source to the two structures and that collects radiation from the two structures.

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168. (New) The apparatus of claim 167, said refractive element having a numerical aperture in the range of about 0.1 to 0.9.

169. (New) The apparatus of claim 168, said refractive element having a numerical aperture in the range of about 0.4 to 0.8.

170. (New) The apparatus of claim 169, said refractive element having a numerical aperture in the range of about 0.5 to 0.7.

171. (New) The apparatus of claim 156, said detectors having an integration time less than about 10 milliseconds.

172. (New) The apparatus of claim 156, said source providing a beam of radiation to illuminate the structures, wherein said optics collects radiation only along one or more directions away from any specular reflection direction of the beam from the reference plane

173. (New) The apparatus of claim 156, said source providing a beam of radiation to illuminate the structures, wherein said optics collects radiation along one or more specular reflection directions of the beam from the reference plane.

174. (New) An imaging method for detecting misalignment of two periodic structures placed next to each other with respect to a reference plane, comprising:

providing radiation to illuminate the two periodic structures;

imaging radiation from the two structures on an array of detectors to form an image of at least portions of each of the two structures on the array, causing the detectors to convert images of said portions to signal outputs, wherein the image of the portion(s)

of one of the two structures is substantially distinct from the image of the portion(s) of the remaining one of the two structures; and

determining a misalignment between the structures by comparing information in said image of portion(s) of one of the two structures to information in said image of portion(s) of the other one of the two structures in signal outputs of the detectors without requiring any interference effects.

175. (New) An imaging apparatus for detecting misalignment of two periodic structures placed next to each other with respect to a reference plane, comprising:

a source providing radiation illuminating the two periodic structures;

an array of detectors;

optics imaging radiation from the two structures on an array of detectors to form an image of at least portions of the two structures on the array, causing the detectors to convert images of said portions to signal outputs, wherein the image of the portion(s) of one of the two structures is substantially distinct from the image of the portion(s) of the remaining one of the two structures; and

a processor determining a misalignment between the structures by comparing information in said image of portion(s) of one of the two structures to information in said image of portion(s) of the other one of the two structures in signal outputs of the detectors without requiring any interference effects.